ANNUAL REPORT FOR 2002

Mud Creek Mitigation Site
Henderson County
Project No. 8.T842404
TIP No. A-10 WM

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North Carolina Department of Transportation
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SUMMARY

The following report summarizes the monitoring activities that occurred in the past year at the Mud Creek mitigation site. Monitoring activities in 2002 represent the fifth year of monitoring after construction in late 1997.

The Mud Creek mitigation site contains ten groundwater-monitoring gauges, one surface water gauge and an Infinity rain gauge. Gauge 4 is located in a wetland area that was enhanced by project implementation. Gauges 5 and 6 are located in the on-site reference wetland. For the 2002 monitoring period no gauges met the success criteria for wetland hydrology.

The vegetation success criterion was met with an average density of 567 trees per acre. This average is well above the minimum success criteria of 320 trees per acre. The Wetland Enhancement Area was monitored utilizing a 30-foot by 100-foot transect to determine the vegetative success of the target species planted in 1998. NCDOT recommends closing the creation area, as it will never meet hydrologic success criteria, and monitoring the enhancement vegetation for one more year in order to meet permitted conditions.

1.0 INTRODUCTION

1.1 Project Description

The Mud Creek Mitigation Site, in Henderson County, encompasses 39.1 acres. The site is located north of Hendersonville, along SR 1528 (Figure 1). It is designed to mitigate for various projects in the French Broad River Basin. Ideally, the Mud Creek site was to provide the following:

- 4.1 acres of creation,
- 26.9 acres of enhancement, and
- 3.1 acres of preservation

However, due to the continual yearly hydrologic failure of the Mud Creek site, NCDOT has recommended to discontinue monitoring activities. Consequently, NCDOT recommends that the mitigation Mud Creek provide the following mitigation:

- 4.1 acres of upland, and
- 26.9 acres of enhancement, and
- 3.1 acres of preservation

This recommendation is proposed based on the Mud Creek Mitigation Plan dated March 12, 1997. As noted on page 27 of that document,

> *"Enhancement of the existing wetlands will occur through planting hardwood species as well as removing the invasive shrub, Chinese Privet. Chinese Privet is an introduced species which can out-compete native species. The removal of privet will allow the colonization of native plant species on the site, which would improve wildlife habitat. The planting of hardwood species would also improve wildlife habitat in this area."*

The success criterion for the enhancement portion of the site was based on grading, clearing an invasive plant, and planting hardwood species. This was done and the planted area was monitored as noted in Section 3.0 of this report.

1.2 Purpose

The Mud Creek Mitigation Site is monitored for both hydrology and vegetation. The 2002 growing season marks the fifth year of monitoring for the site. The following report describes the results of both hydrologic and vegetative monitoring for 2002.

1.3 Project History

November 1997	Grading Construction
February-March 1998	Tree Planting
March 1998	Monitoring Gages Installed
April- October 1998	Hydrologic Monitoring (1 yr)
September 1998	Vegetation Monitoring (1 yr)
April- October 1999	Hydrologic Monitoring (2 yr)
August 1999	Vegetation Monitoring (2 yr)
April – October 2000	Hydrologic Monitoring (3 yr)
September 2000	Vegetation Monitoring (3 yr.)
April – October 2001	Hydrologic Monitoring (4 yr.)
July 2001	Vegetation Monitoring (4 yr.)
April – October 2002	Hydrologic Monitoring (5 yr.)
July 2002	Vegetation Monitoring (5 yr.)

1.4 Debit Ledger

Mud Creek	Mit. Plan				TIP DEBIT
Henderson Co.					
Habitat	Acres at Start:	Acres Remaining	% Remaining		R-2116B
BLH Creation	0	0	0.0		0
BLH Enhancement	26.9	12.5	46.47		14.4
Wet Meadow Preservation	3.1	3.1	100.00		
TOTAL	30.0	15.6	52.0		14.4

Note: US Army Corps of Engineers Action ID Numbers: 199707179, 199707180 Division of Water Quality Project No. 970440. The above debit ledger has been changed based upon agency comments at the 2002 Annual Monitoring Report Meeting, March 12, 2003.

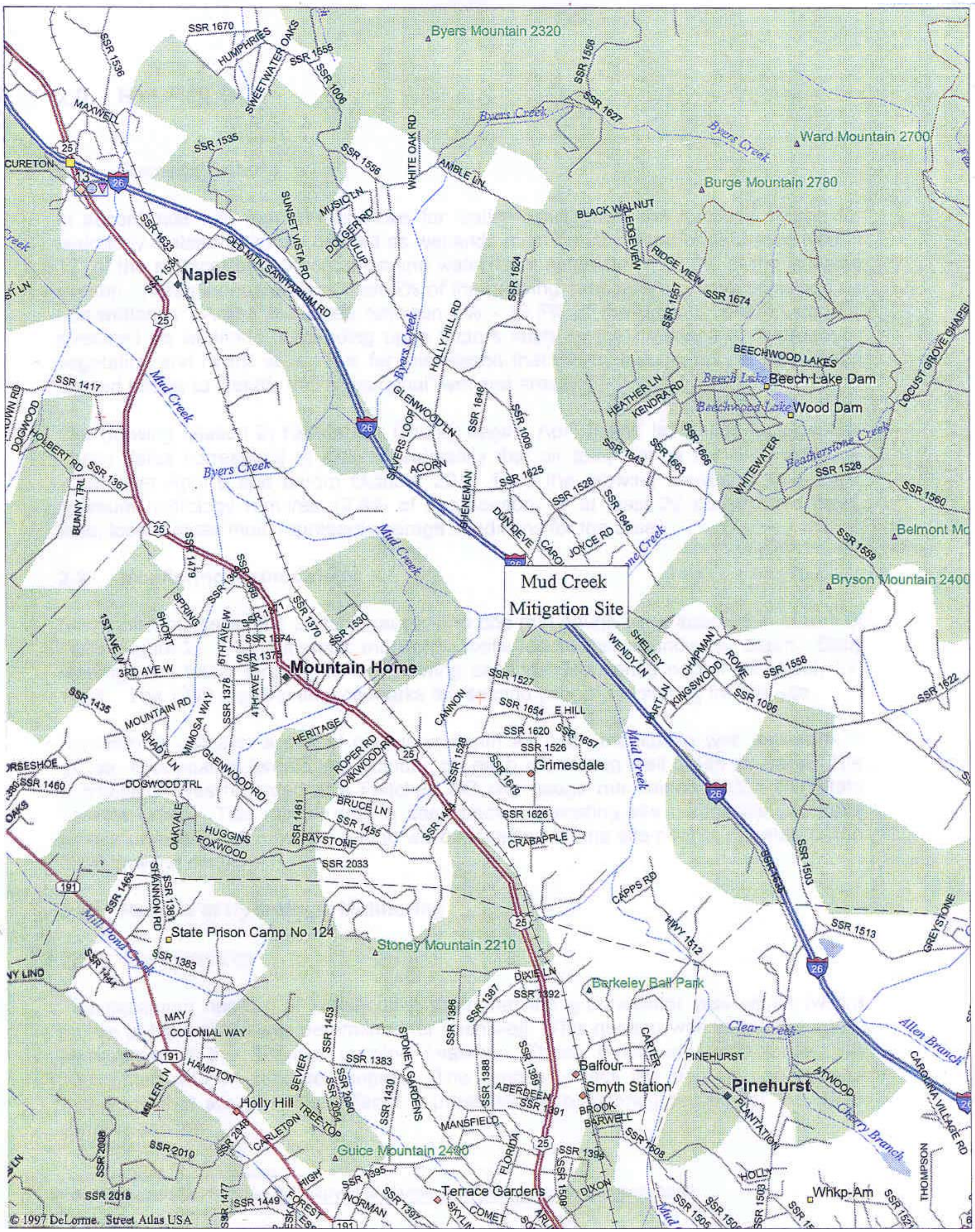
Mud Creek
Mitigation Site
Byers Mountain 2320
Ward Mountain 2700
Burge Mountain 2780
Belmont Mo
Bryson Mountain 2400
Stoney Mountain 2210
Guice Mountain 2400
Naples
Mountain Home
Pinehurst
Grimesdale
Balfour
Smyth Station
Holly Hill
Terrace Gardens
State Prison Camp No 124
Barkeley Ball Park
Whkp-Am
Beech Lake Dam
Wood Dam
Beech Lake
Beechwood Lake
Byers Creek
Mud Creek
Featherstone Creek
Mill Pond Creek
Clear Creek
Allen Branch
Cherry Branch
CURETON
MAXWELL
HUMPHRIES
SWEETWATER OAKS
SSR 1670
SSR 1536
SSR 1555
SSR 1006
SSR 1535
SSR 1556
SSR 1627
WHITE OAK RD
AMBLE LN
SUNSET VISTA RD
MUSIC LN
DOLGER RD
TULIP
OLD MTN SANITARIUM RD
SSR 1633
SSR 1624
HOLLY HILL RD
BLACK WALNUT
LEDGEVIEW
RIDGE VIEW
SSR 1657
SSR 1674
BEECHWOOD LAKES
LOCUST GROVE CHAPEL
HEATHER LN
KENDRA RD
SSR 1417
DOGWOOD
HOLBERT RD
SSR 1367
BUNNY TRL
GLENWOOD LN
SSR 1648
ACORN
SHENEMAN
SSR 1625
SSR 1528
SSR 1646
SSR 1643
SSR 1663
SSR 1666
WHITEWATER
SSR 1560
SSR 1559
DUNDEVE
JOYCE RD
SSR 1479
SPRING
SHORT
1ST AVE W
3RD AVE W
6TH AVE W
4TH AVE W
SSR 1374
SSR 1370
SSR 1530
SSR 1378
SSR 1435
MOUNTAIN RD
SHADY LN
MIMOSA WAY
GLENWOOD RD
HERITAGE
ROPER RD
OAKWOOD RD
CANNON
SSR 1527
SSR 1654
E HILL
SSR 1620
SSR 1657
SSR 1526
SSR 1619
SHELLEY
WENDY LN
CHAPMAN
KINGSWOOD
ROWE
SSR 1558
SSR 1006
SSR 1622
DOGWOOD TRL
SSR 1460
OAKVALE
HUGGINS
FOXWOOD
SSR 1461
BRUCE LN
SSR 1455
BAYSTONE
SSR 2033
SSR 1528
SSR 1626
CRABAPPLE
CAPPS RD
SSR 1503
SSR 1513
GREYSTONE
HWY 1512
SHANNON RD
SSR 1381
SSR 1383
MAY
COLONIAL WAY
HAMPTON
MILLER LN
SSR 2008
SSR 2010
SSR 2018
SSR 2048
CARLETON
TREE TOP
SEVIER
SSR 1453
SSR 2050
SSR 2054
SSR 1430
STONEY GARDENS
SSR 1386
SSR 1387
SSR 1388
SSR 1389
ABERDEEN
SSR 1391
MANSFIELD
FLORIDA
DIXIE LN
SSR 1392
CARTER
PINEHURST
BROOK
BARWELL
SSR 1508
PLANTATION
ATWOOD
CAROLINA VILLAGE RD
THOMPSON
HOLLY
DIXON
SSR 1449
SSR 1477
FOREST
HIGH
NORMAN
COMET
SSR 1505
SSR 1503
© 1997 DeLorme. Street Atlas USA

Figure 1 - Site Location Map

2.0 HYDROLOGY

2.1 Success Criteria

In accordance with federal guidelines for wetland mitigation, the success criteria for hydrology states that areas defined as wetlands must be inundated or saturated (within 12" of the surface) by surface or ground water for a consecutive 12.5% of the growing season. Areas inundated less than 5% of the growing season are always classified as non-wetlands. Areas inundated between 5% and 12.5% of the growing season can be classified as wetlands, depending upon factors such as the presence of hydrophytic vegetation and hydric soils. It is for this reason that the hydrologic results have been divided further to identify these "marginal" wetland areas.

The growing season in Henderson County begins April 9 and lasts until October 29. These dates correspond to a 50% probability that air temperature will drop to 28° F or lower after April 9 and before October 29.[1] Thus the growing season is 204 days; optimum hydrology requires 12.5% of this season, or at least 26 consecutive days. Eight percent of the growing season corresponds to at least 16 consecutive days and 5% corresponds to at least 10 consecutive days. Also, local climate must represent average conditions for the area.

2.2 Monitoring Methodology

Six monitoring gauges, one surface gauge, and one rain gauge were installed in March of 1998 and an additional four monitoring gauges and an Infinity rain gauge were installed in April 2000 (Figure 2). The automatic monitoring gauges and rain gauge record depth to groundwater and rainfall, respectively. Daily readings are taken throughout the growing season. Monitoring began on March 27, 1998. The 2002 growing season marks the fifth year of monitoring for this site.

Appendix A contains a plot of the water depth for each monitoring gauge and surface gauge. Precipitation events are included on each monitoring gauge graph as bars.

2.3 Results of Hydrologic Monitoring

2.3.1 Site Hydrology

The maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each well. This number was

[1] Soil Conservation Service, Soil Survey of Henderson County, North Carolina, 1980.

converted into a percentage of the 204-day growing season. These monitoring gauge results are segmented into percentage ranges.

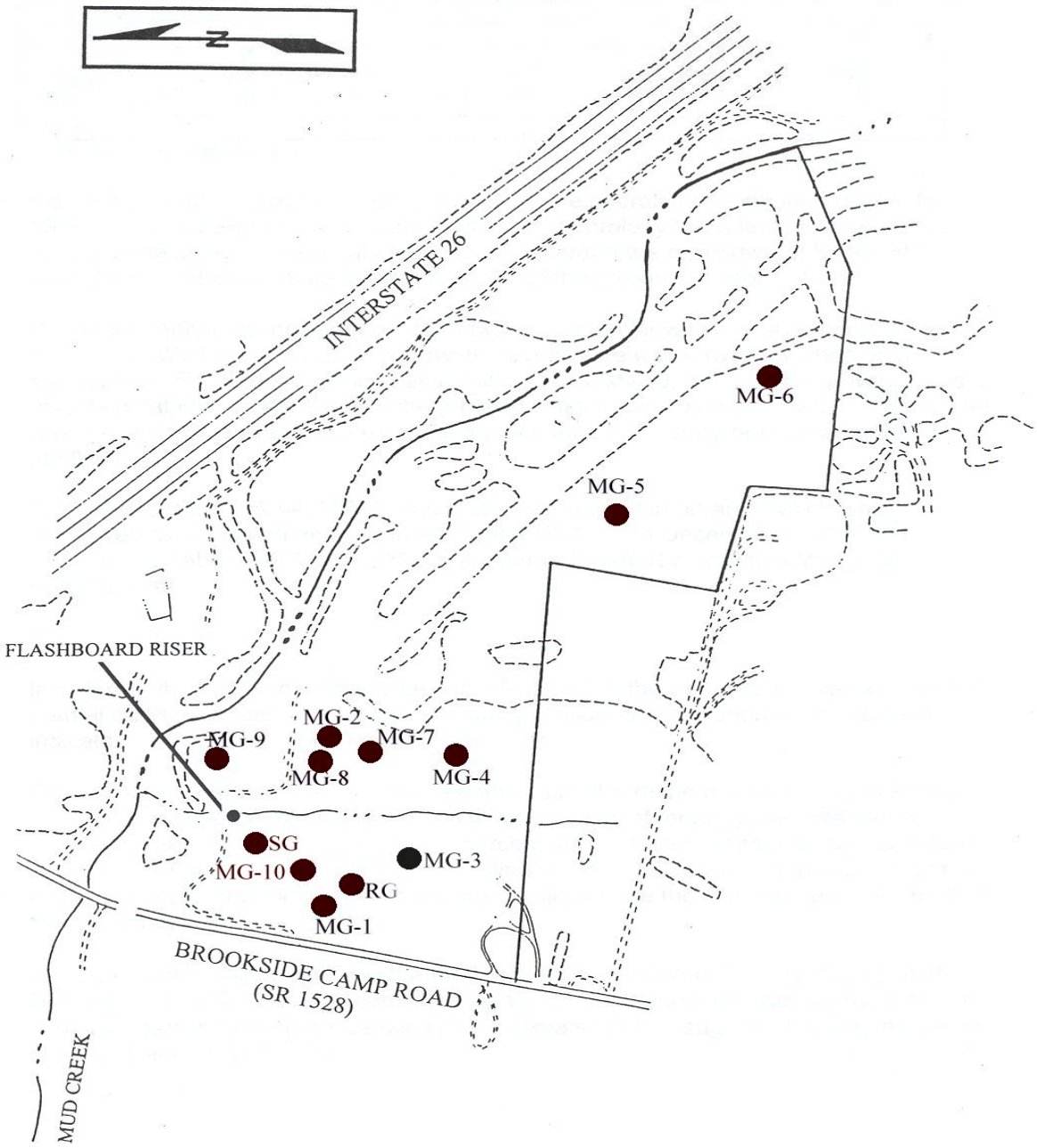

Figure 2. Monitoring Gauge Location Map degrees of wetland hydrology that are possible.

2002 HYDROLOGIC MONITORING RESULTS

Monitoring Well	< 5%	5% - 8%	8% - 12.5%	> 12.5%	Actual %
MG-1	✔				.49
MG-2	✔				0
MG-3		✔			6.86
MG-4		✔			5.88
MG-5 (RG)	✔				3.92
MG-6 (RG)	✔				3.92
MG-7	✔				3.92
MG-8	✔				0
MG-9	✔				1.47
MG-10	✔				4.90

(RG) indicates a reference gauge.

Table 1

Table 1 presents the monitoring results for the 2002-growing season.

Specific gauge problems:

- Gauges MG-5 and MG-6 could not be downloaded April 17-July19 due to both gauges being vandalized.
- Gauge MG-1 stopped recording data September 6. The gauge was replaced and programmed to begin recording data October 14.

Figure 3. Provides a graphical representation of the hydrologic monitoring results for 2002. Gauges labeled in blue represent optimum hydrology for at least a consecutive 12.5% of the season. Gauges labeled in green recorded the groundwater level within twelve inches of the surface between 5 and 8% of the growing season. Gauges labeled in black recorded the groundwater level within twelve inches of the surface for less than 5% of the growing season. Based on the performance of the 2002 monitoring period, all gauges have been coded black.

For 2002 growing season, no gauges met the success criteria of 12.5%.

2.3.2 Climatic Data

In order for the hydrologic data to be considered valid, the area must have experienced normal climatic conditions during the growing season. Precipitation is one climatic indicator.

Figure 4 is a comparison of the 2002 monthly rainfall with the historical rainfall for the area. The lines represent the 30th and 70th percentiles of monthly precipitation for Hendersonville, North Carolina. These percentiles are based on rainfall data collected between 1971 and 2002 from a National Climatic Data Center official gauge and serve as the historical data for the area. The percentiles create the "normal range" for rainfall for the vicinity.

The bars on the graph represent the total monthly rainfall from January through October of 2002. The 2002 rain data was provided by the on-site Infinity rain gauge. The historic rainfall data was obtained from the North Carolina State Climatic Office (NCSCO) in Hendersonville, North Carolina.

Data for Henderson County shows that the area experienced normal rainfall during the months of January, March, May, September, and October. Henderson County was below average during February, April, June, July, and August. November and December data was not included since the end of the growing season is October 29th.

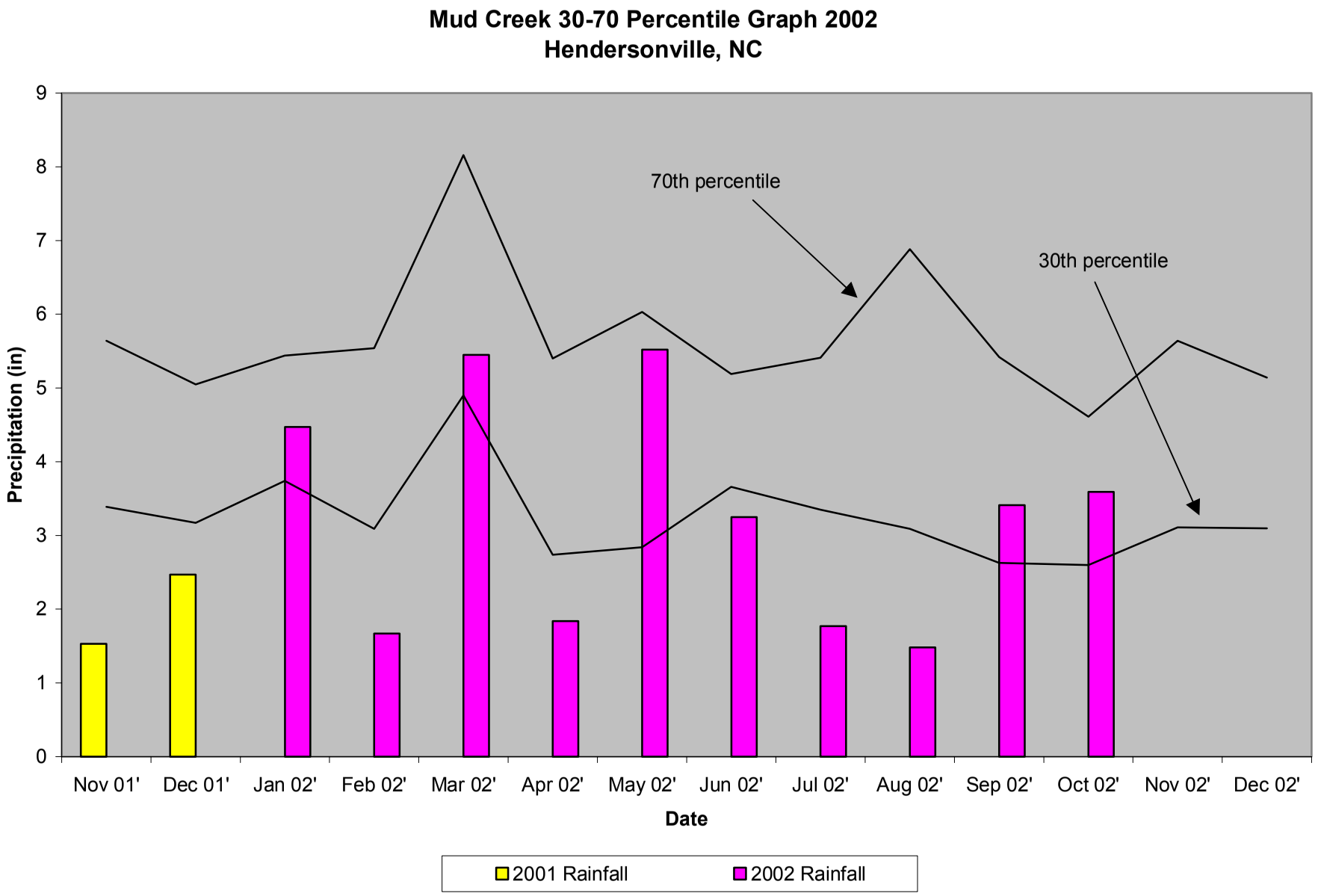
Mud Creek 30-70 Percentile Graph 2002
Hendersonville, NC
Precipitation (in)
0
1
2
3
4
5
6
7
8
9
70th percentile
30th percentile
Nov 01'
Dec 01'
Jan 02'
Feb 02'
Mar 02'
Apr 02'
May 02'
Jun 02'
Jul 02'
Aug 02'
Sep 02'
Oct 02'
Nov 02'
Dec 02'
Date
2001 Rainfall
2002 Rainfall

Figure 3

2.4 Conclusions

For the 2002 monitoring period no gauges indicated wetland hydrology. MG-3 and MG-4 displayed the overall highest reading and met between 5% and 8%. Of the remaining nine gauges MG-1, MG-2, MG-7 and MG-8 are located in areas of constructed wetland. MG-5 and MG-6 are located in an existing wetland that has not been impacted.

Based on the continued lack of success within the creation portion of the site, NCDOT recommends discontinuing the hydrologic monitoring activities. Based on the success of the vegetation planted in the Wetland Enhancement Area in the fifth year of monitoring (three-year required per the Plan), NCDOT recommends discontinuing monitoring activities. The 4.1 acres of proposed wetland creation failed and will be deducted from the wetland totals of the site and noted in the Debit Ledger through coordination with permitting agencies. Only 1 acre of creation has been debited from the site. The 4.1 acres of failed creation will be shown as uplands on the debit ledger. Four acres of enhancement is proposed to offset the 1acre of creation.

3.0 VEGETATION: MUD CREEK MITIGATION SITE (YEAR 5 MONITORING)

3.1 Success Criteria

Success Criteria states that there must be a minimum of 320 trees per acre surviving after three years.

3.2 Description of Species

The following tree species were planted in the Wetland Enhancement Area:

Betula nigra, River Birch

Fraxinus pennsylvanica, Green Ash

Nyssa sylvatica, Blackgum

Quercus phellos, Willow Oak

Diospyros virginiana, Persimmon

Juglans nigra, Black Walnut

Prunus serotina, Black Cherry

3.3 Results of Vegetation Monitoring (4 year)

TABLE 2 – VEGETATIVE MONITORING RESULTS

Plot #	Green Ash	Blackgum	River Birch	Willow Oak	Persimmon	Black Walnut	Tulip Poplar	Total (5 year)	Total (at planting)	Density (Trees/Acre)
8	5	5	4	3	4	1		22	33	453
Transect	25	5	10	5			5	50	50	680
	Average Tree Density									**567**

Site Notes: Other species noted: goldenrod, Queen-Anne's-lace, clover, black willow, *Juncus* sp., sycamore, silver maple, dogwood, privet, and multiflora rose.

Transect: A 100' x 30' (0.07 acre) transect was installed within the Wetland Enhancement Area during the July 2001 monitoring visit. GPS coordinates for this transect could not be obtained due to the dense tree canopy cover. The approximate location of the transect is shown on the attached map.

3.4 Conclusions

Of the 39.1 acres on this site, approximately 9.4 acres involved tree planting. There were 8 vegetation monitoring plots established throughout the planting areas and one transect established within the enhancement area. The 2002 vegetation monitoring of

the site revealed an average tree density of 567 trees per acre. This average is well above the minimum success criteria of 320 trees per acre. All plots met the success criteria. Due to hydrologic failure on site, only the enhancement area (plot 8 and transect) was monitored during 2002 monitoring season.
NCDOT proposes to discontinue all vegetation monitoring at the Mud Creek Mitigation Site.

4.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

From a vegetative standpoint, Mud Creek appears to be very successful. From a hydrological standpoint, Mud Creek will never meet the success criteria other than during a higher than average rainfall year. However, yearly rainfall must remain in the "normal" range to meet hydrologic success. The upstream impoundment limits the amount of surface water runoff into the site.

The created wetland portion of the site will never meet the hydrologic success criteria as proposed in the Mud Creek Monitoring Plan. The Wetland Enhancement Area of the site has met the success criteria for enhancement as proposed in the Mud Creek Mitigation plan.

The Debit Ledger will be adjusted through coordination with the permitting agencies. Only one acre of creation has been debited from the site. The 4.1 acres of failed creation will be shown as uplands on the debit ledger. Four acres of enhancement is proposed to offset the one acre of creation deficit. NCDOT recommends closing the creation area of the site since this portion of the site will not meet the hydrologic success criteria. There are no viable remediation options available. The enhancement section will be monitored for one more year in order to fulfill permit requirements. NCDOT will discuss these recommendations with the regulatory agencies at the annual monitoring review meeting.

APPENDIX A

DEPTH TO GROUNDWATER PLOTS

APPENDIX B

SITE PHOTOS & VEGETATION PLOT LOCATION MAP

MUD CREEK

Photo 1 (Transect)

Photo 2

Photo 3

Photo 4

Photo 5

2002

MUD CREEK MITIGATION SITE

PROJECT REFERENCE NO.	SHEET NO.
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

FLOT AND PHOTO LOCATIONS